



U.S. Department of Energy  
Energy Efficiency and Renewable Energy



## *Leading Our Nation Towards Energy Independence*

*Neil Ross meissl  
Hydrogen, Fuel Cells and  
Infrastructure Technologies*

Presentation to  
Southeast Regional  
Hydrogen Infrastructure Forum  
April 29, 2003  
Florida Solar Energy Center

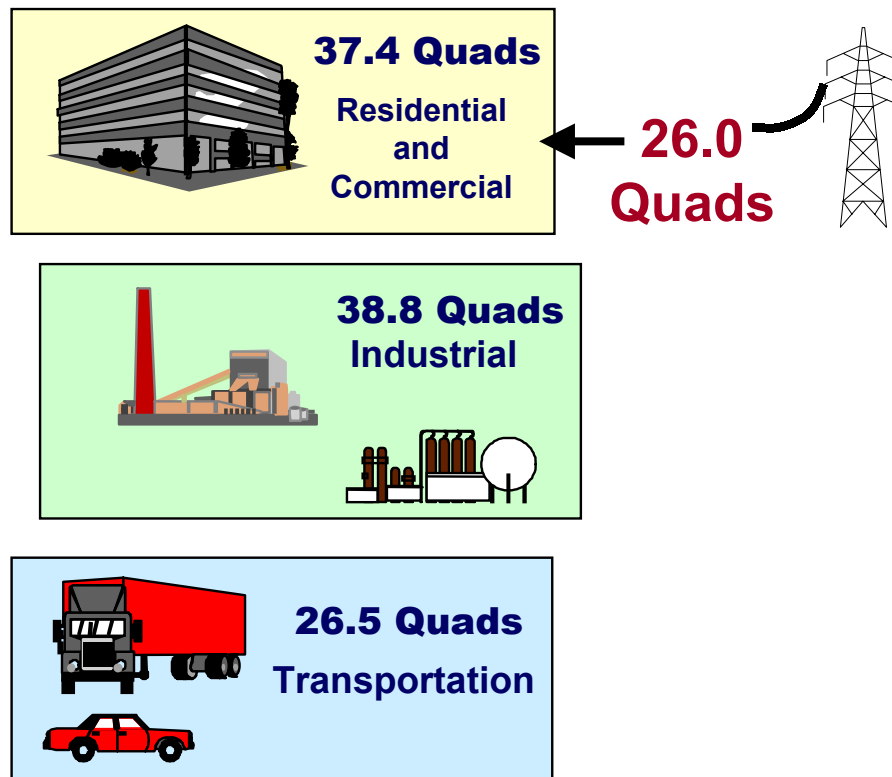
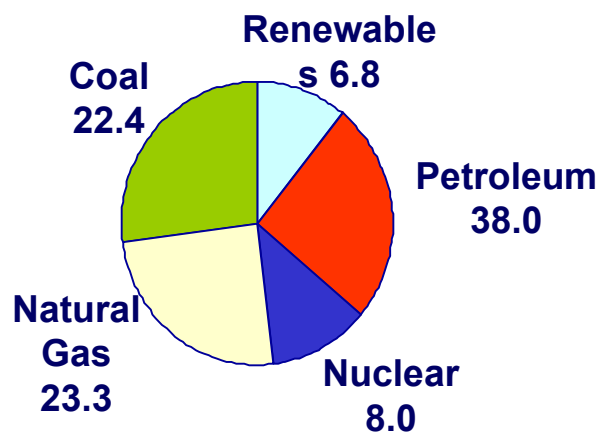


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# U.S. Energy Consumption

## 2000

**98.5 Quads  
(Quadrillion Btu)**



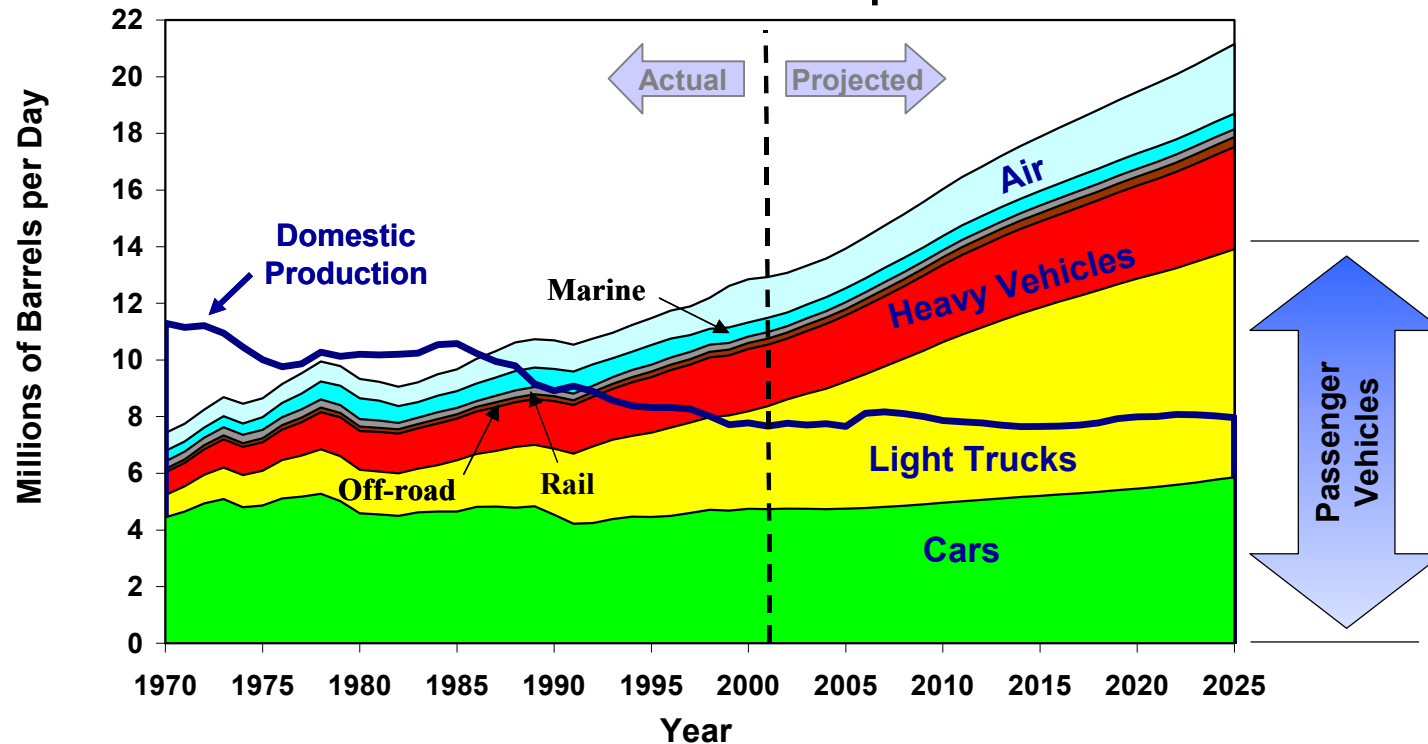
Source: U.S. DOE Energy Information Administration "Annual Energy Review 2000"



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# U.S. Energy Dependence is Driven By Transportation

## US Oil Use for Transportation



Source: Transportation Energy Data Book: Edition 22, September 2002,  
and EIA Annual Energy Outlook 2003, January 2003

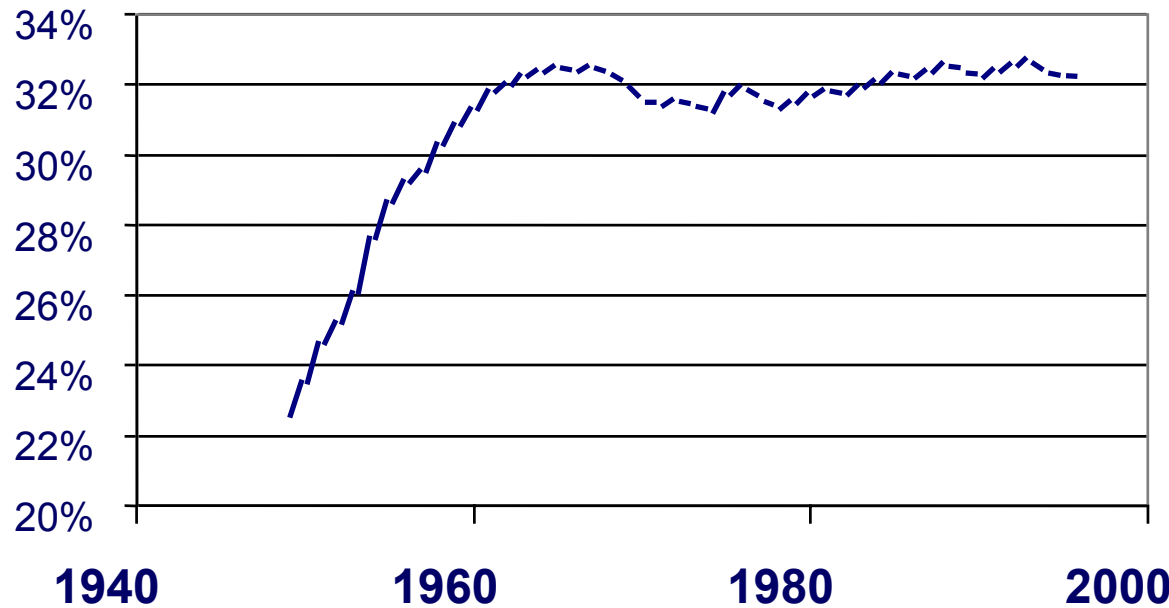
- Transportation accounts for 2/3 of the 20 million barrels of oil our nation uses each day.
- The U.S. imports 55 % of its oil, expected to grow to 68 % by 2025 under the status quo.
- Nearly all of our cars and trucks currently run on either gasoline or diesel fuel.



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# Electric System

## Stagnant Efficiency



**Fossil Electric Generation Efficiency (at plant, W/O T&D)**

**U.S. electricity conversion losses totaled 27.1 quads in 2000, enough energy to fuel Japan.**

Source: EIA, Annual Energy Review 1996





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## President Bush Launches the Hydrogen Fuel Initiative

"Tonight I am proposing \$1.2 billion in research funding so that America can lead the world in developing clean, hydrogen-powered automobiles.

"A simple chemical reaction between hydrogen and oxygen generates energy, which can be used to power a car producing only water, not exhaust fumes.

"With a new national commitment, our scientists and engineers will overcome obstacles to taking these cars from laboratory to showroom so that the first car driven by a child born today could be powered by hydrogen, and pollution-free.

"Join me in this important innovation to make our air significantly cleaner, and our country much less dependent on foreign sources of energy."

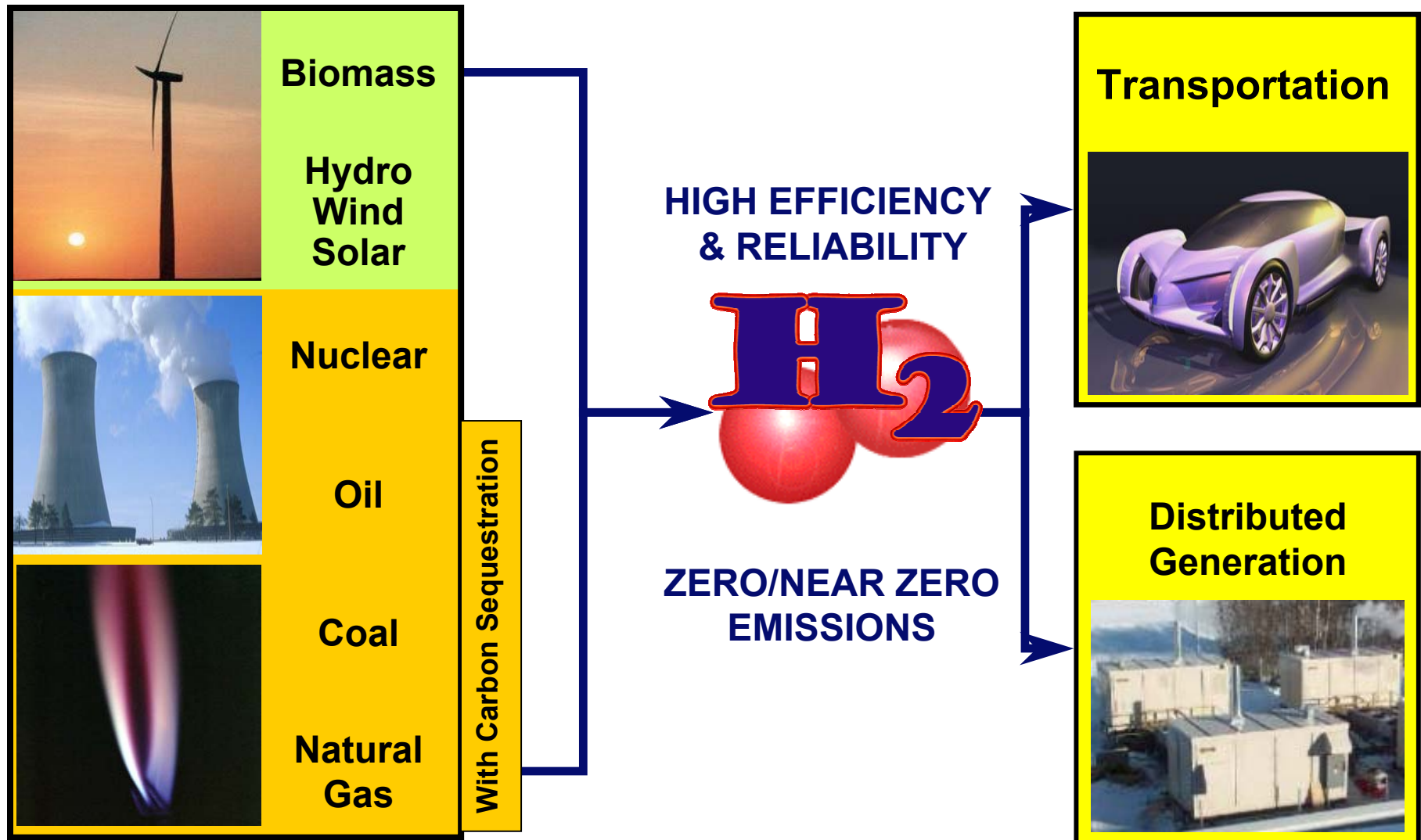


2003 State of the Union Address  
January 28, 2003



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*Why Hydrogen? It's abundant,  
clean, efficient, and can be derived  
from diverse domestic resources.*





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# *President's Hydrogen Fuel Initiative Complements FreedomCAR*

- Freedom from foreign petroleum dependence
- Freedom from pollutant and carbon dioxide emissions
- Freedom for Americans to drive where they want, when they want, in the vehicle of their choice
- Freedom to obtain fuel affordably and conveniently



*On January 9, 2002, Energy Secretary Abraham announced the FreedomCAR Partnership*



**FreedomCAR and Fuel  
Initiative**

**H<sub>2</sub>**





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## *President's FreedomCAR and Fuel Initiatives*



DOE partners with USCAR and energy companies to develop hydrogen and fuel cell technologies simultaneously:

- ❖ FreedomCAR focuses on fuel cell vehicle and hybrid component technologies
- ❖ Hydrogen Fuel Initiative focuses on hydrogen storage and production and delivery infrastructure technologies

*Government leadership will help advance commercialization of hydrogen fuel cell vehicles and infrastructure by 15 years, from approximately 2030 to 2015.*





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# *Hydrogen Infrastructure and Fuel Cell Technologies put on an Accelerated Schedule*

- President Bush commits \$1.7 billion over first 5 years:
  - ❖ \$1.2 billion for hydrogen and fuel cells RD&D (\$720 million in new money)
  - ❖ \$0.5 billion for hybrid and vehicle technologies RD&D
- Accelerated, parallel track enables industry commercialization decision by 2015.



***Fuel Cell Vehicles in the Showroom  
and Hydrogen at Fueling Stations  
by 2020***



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# *The President's FY04 Budget Request for FreedomCAR and Hydrogen Fuel Initiatives*

Organization	Million \$
Hydrogen, Fuel Cells & Infrastructure Technologies Program (EERE)	165.5
FreedomCAR and Vehicle Technologies Program (EERE)	91.1
Office of Fossil Energy (FE)	11.5
Office of Nuclear Energy, Science and Technology (NE)	4.0
Department of Transportation (RSPA)	0.7
<b>Total</b>	<b>272.8</b>



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# Fiscal Year 2004 Hydrogen Production Funding (\$38.5M)

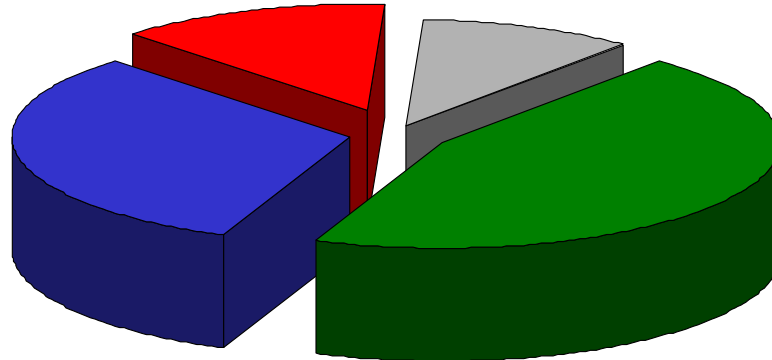
**The Department of Energy's Offices of Fossil Energy, Nuclear Energy, and Energy Efficiency and Renewable Energy are collaborating on cost-shared hydrogen production R&D:**

## Coal - \$5 million (FE)

- Separation of pure hydrogen gas from synthesis gas (CO and hydrogen)
- Technologies also applicable to biomass feedstocks

## Nuclear - \$4 million (NE)

- High temperature chemical cycles for splitting water



## Natural Gas – \$12.2 million (FE/EERE)

- Small, distributed systems to begin making hydrogen available at local refueling stations
- Centralized Production

## Renewables - \$17.3 million (EERE)

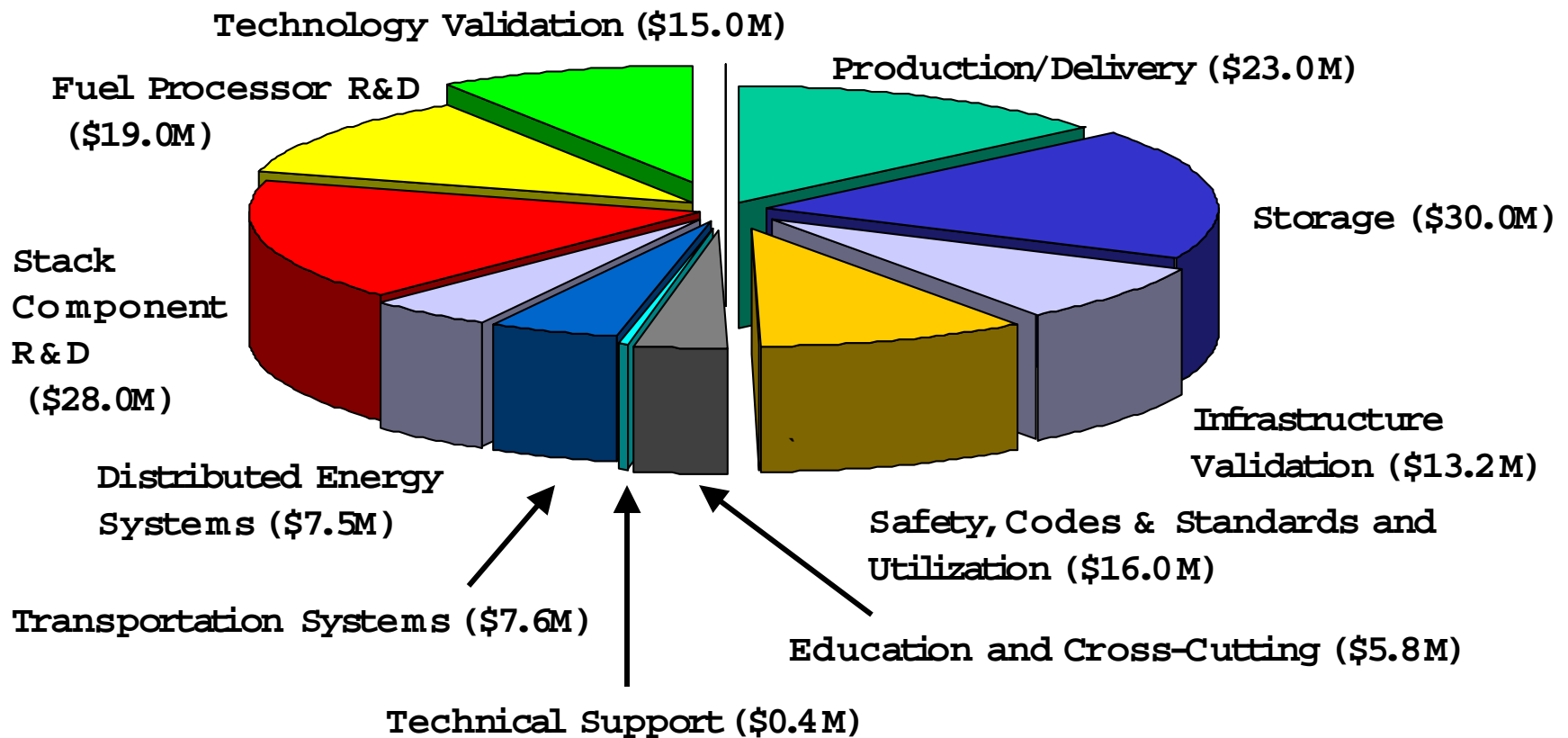
- Direct water splitting using solar energy
- Thermal processes using biomass
- Advanced electrolysis from wind power
- Biological WGS Processes

**Energy Independence through Diversity of Domestic Supplies**



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# *FY04 EERE Hydrogen and Fuel Cell Budget Request (Key Activities)*



*Total FY 04 Request \$165.5M*





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# Hydrogen, Fuel Cells and Infrastructure Technologies Program

**Program Focus:** Research, develop, and validate fuel cell and hydrogen production, delivery and storage technologies for transportation and stationary applications

Major Activities	FY02 Approp.	FY03 Approp.	FY04 Request
Hydrogen Production & Delivery	\$11.2M	\$11.8M	\$23.0M
Hydrogen Storage	\$6.1M	\$11.3M	\$30.0M
Safety, Codes & Standards, Education	\$5.9M	\$6.8M	\$21.8M
H2 Infrastructure/FC Vehicle Demo	\$5.7M	\$11.9M	\$28.2M
Fuel Cell Systems & Components	\$46.7M	\$53.7M	\$62.5M
<b>TOTAL</b>	<b>\$75.6M</b>	<b>\$95.5M</b>	<b>\$165.5M</b>



## Highlights

- Advanced production technologies (reforming, separation, photoelectro-chemical, photobiological, electrolysis)
- Solid-state hydrogen storage materials (carbon, hydrides, etc.)
- **Mandate: lead and accelerate codes, standards and safety development and implementation**
- Integrated fuel cell vehicle and hydrogen infrastructure technology validation
- Fuel cell stack component cost reduction (catalyst & membrane) and stationary systems development



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# Hydrogen, Fuel Cells and Infrastructure Technologies Program

**Codes, Standards, & Safety Focus:** Facilitate the development and adoption of building codes and equipment standards; international standards, and safe practices that promote insurability.

## Barriers



- Historical data is limited
- Rationale for current practice cannot be verified.
- Local government, Fire Marshal and public perceptions are shaped by past history.
- Creation and adoption of new codes and standards is a slow process.
- Standards can be used as a trade barrier.



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*What's New?*

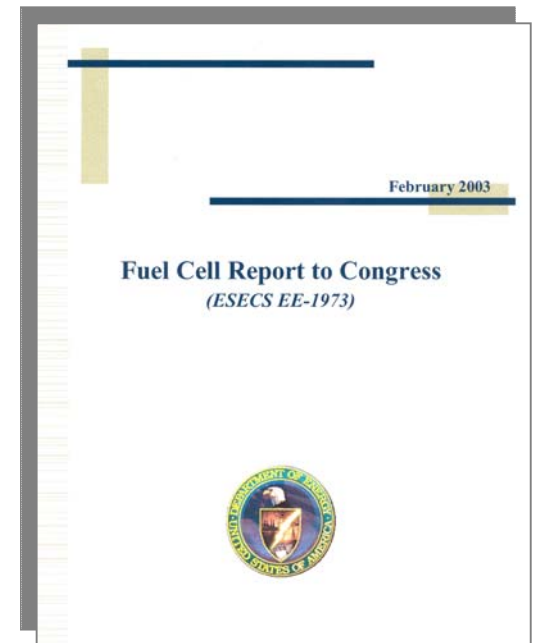
## ***Fuel Cell Report to Congress***

### ***Need for Public/Private Partnerships***

- Stationary and Distributed Generation to continue robust research activities to
  - lower costs and improve durability, and
  - establish field evaluations.
- Transportation and Infrastructure to establish learning demonstrations of fuel cell vehicles and hydrogen infrastructure.

### ***Program Adjustments***

- Core Technology Development re-focused on advancements to lower cost and increase durability.
- Increased emphasis on hydrogen production and delivery infrastructure, storage, codes and standards development, and education.





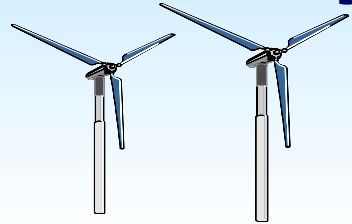
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# "Convergence"

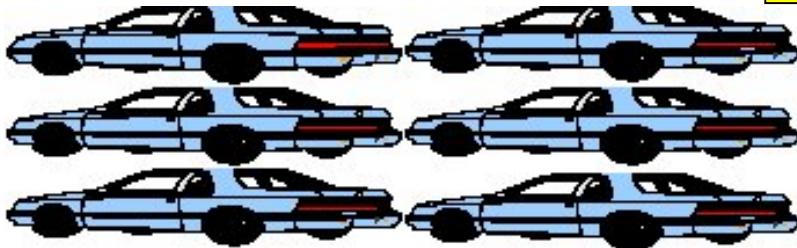
## Transportation and Electric Power

### Power Park- Fueling Station

Renewable energy

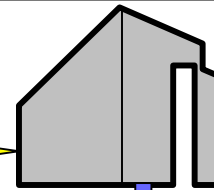


Co-production  
of  $H_2$  for  
refueling and  
electricity

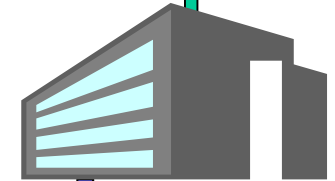


Natural Gas Pipeline

Reversible Fuel Cell



Fuel Cell



Hydrogen

Electricity



Hydrogen Storage







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## *Near Term Opportunities for Hydrogen and Fuel Cell R,D,&D*

- **Hydrogen Production**

- E O P I requesting candidate research topics closes March 14, 2003
- Anticipated Solicitation Release – June 2003

- **Hydrogen Storage**

- Anticipated Solicitation Release – April 2003

- **Fuel Cells**

- Stationary/Automotive Applications proposals due March 27, 2003
- Portable/Auxiliary Power Units – Solicitation Release – March 2003

- **Technology Evaluation & Validation**

- Pre-solicitation conference – March 19, 2003
- Anticipated Solicitation Release – April 2003

- **Codes/Standards**

- Multiple Solicitations Anticipated – late 2003

- **Education**

- 2003 State Energy Program Special Projects – Proposals from states due May 19, 2003



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*For more information:*

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